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A COMPARISON OF BIRD COMMUNITIES IN BURNED AND SALVAGE-LOGGED, CLEARCUT, AND FORESTED FLORIDA SAND PINE SCRUB

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Abstract.—We hypothesized that similar bird assemblages will occur in like-structured habitat that results from both clearcutting and high-intensity wildfire followed by salvage logging. To test this, we compared bird communities of sand pine scrub in mature forest and three disturbance treatments (1) high-intensity wildfire, salvage logged, and naturally regenerated, (2) clearcut, roller chopped, and broadcast seeded, and (3) clearcut and bracke-seeded. We analyzed communities based on residency status and nesting guilds. Migratory breeding birds were nearly restricted to mature forest. Bird communities of mature forest were significantly more species rich and diverse than those of disturbance treatments in spring. However, species richness and diversity of migratory winter residents did not differ among treatments, indicating that they are habitat-structure generalists on their wintering grounds. Canopy- and cavity-nesters and canopy- and bark-foraging species were virtually restricted to mature forest. Most species recorded in mature sand pine forest or disturbance treatments were either habitat-structure generalists or also occurred in other similarly structured vegetation types. However, the threatened and endemic Florida Scrub Jay (*Aphelocoma c. coerulescens*) occurred only in disturbance treatments (no differences). Silvicultural disturbance appears to mimic the natural high-intensity disturbance regime by creating habitat structural features required by open scrub species and may be an important habitat management tool where the use of wildfire is impractical. However, long-term effects, unsalvaged burns, and landscape patterns created by clearcutting were not addressed and may also be important in structuring bird communities of sand pine scrub. *Received 5 Jan. 1994, accepted 22 Aug. 1994.*

The influence of vertical and horizontal vegetation structure on bird communities is well known (MacArthur and MacArthur 1961, Cody 1968, James and Wamer 1982, Brown 1992). Natural disturbance plays a critical role in structuring habitat (Mushinsky and Gibson 1991). The impact of natural disturbance varies among ecosystems (Bormann and Likens 1979) in conjunction with the intensity, frequency, type, and size of the disturbance (Miller 1982).

Sand pine (*Pinus clausa*) scrub is a sclerophyllous, shrub-dominated ecosystem occurring on xeric, infertile sand (Kalisz and Stone 1984) in Florida and extreme southern Alabama. The shrub layer is dominated by

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myrtle oak (*Quercus myrtifolia*), sand live oak (*Q. geminata*), Chapman's oak (*Q. chapmanii*), crookedwood (*Lyonia ferruginea*), and two species of palmetto (*Serenoa repens* and *Sabal etonia*). Herbaceous groundcover is scant. The canopy is limited to a single species—sand pine.

Historically, low frequency, high-intensity, and large-scale wildfire created a temporally shifting age-class mosaic in peninsular sand pine scrub (Bartram 1791, Rawlings 1933, Webber 1935, Myers 1990). Semi-serotinous sand pine cones release copious quantities of seed (>2.47 million/ha) following high-intensity wildfire (Cooper et al. 1959), naturally creating often vast areas of even-age, monospecific sand pine stands. An open, shrub-dominated habitat was maintained between wildfires, while mature forest existed intermittently in time and space, especially on protected sites.

The avifauna of sand pine scrub has low endemism (Woolfenden 1969, 1970; Breininger and Schmalzer 1990). Only the threatened and endemic Florida Scrub Jay (*Aphelocoma c. coerulescens*) is restricted to scrub. Within scrub, jays inhabit only short-statured, oak-dominated habitat with patches of bare sand (Breininger 1981, Woolfenden and Fitzpatrick 1984). This habitat structure is available between approximately 3–15 years post-disturbance.

The Ocala National Forest in central Florida contains the largest remaining area of the endangered sand pine scrub ecosystem. Most has been lost to citrus or urban development (Myers 1990). Current forest management of sand pine scrub in the Ocala National Forest entails clearcutting patches of approximately 8–24 ha commonly followed by either roller chopping (nearly 100% soil surface disturbance) or bracke seeding, which creates small seed beds disturbing about 30% of the soil surface (Outcalt 1990). Because of the wood fiber value and the possibility of large-scale, uncontrolled burns, fires in sand pine stands are usually extinguished as rapidly as possible. Normally, burned sites are salvage-logged.

Plant community recovery and the subsequent habitat structure in clearcuts is similar in many respects to that following high-intensity wildfire (Abrahamson 1984a, b; Schmalzer and Hinkle 1992). Major differences include the presence of relatively few standing trees or snags for at least five years following wildfire, more slash piles, and less bole-sized woody debris in clearcuts versus burned sites (pers. obs.). Landscape patterns such as patch size and connectivity also differ between the two disturbance types.

Where the use of high-intensity wildfire is unfeasible for safety and economic reasons, other tools for maintaining early successional habitat must be sought. We predicted that bird assemblages would respond similarly to habitat structure resulting from high-intensity disturbance regardless of means. We tested this hypothesis by comparing bird communities of clearcuts and of catastrophically burned, salvage-logged sites.

METHODS

We sampled the habitat structure of sand pine scrub in five replicate sites for each of three, 5- to 7-year-old disturbance treatments and mature forest. Treatments were (1) high-intensity burn, salvage logged, and naturally regenerated (HIB); (2) clearcut, roller chopped, and broadcast seeded (RC); and (3) clearcut and bracke seeded (BK). Mature (≥55 years), virgin sand pine stands that had been naturally regenerated following a stand-replacing fire in 1935 were used as the "control" treatment (MF).

Sand pine height and density were measured in five 10 × 10-m quadrats per site. Percent cover of shrub, bare ground, and herbaceous plants were measured using three 10-m line transects randomly placed within each quadrat.

We sampled birds in three replicate sites for each treatment. Three strip transects (20 × 250 m) were randomly established on each site (O'Meara et al. 1985), spaced a minimum of 100 m (plus a randomly chosen distance) apart. Transect locations were influenced by stand shape and size; all were a minimum of 50 m from stand or roadside edges except where prohibited by stand shape (two transects came within 20 m of edges for short distances). Transect width was restricted to 20 m to minimize variation due to visibility among sites and differences in detectability among species or season (detectability was greatly reduced in winter) (Emlen 1971, Robbins 1978). Narrow transect widths also increased the likelihood of detecting and distinguishing among individuals. Some species using treatment sites were not recorded within transects, but these generally were species that rarely used sites or those traveling in winter flocks beyond transect boundaries. This method standardized comparisons among treatments and overall appeared to reflect accurately the community composition.

We surveyed birds during breeding season (19 May–29 June) and winter (3 January–13 February) for two years (spring 1991 through winter 1993). Counts were conducted on each transect of each site four times during each season (Conner and Dickson 1980) by walking along the center line of the transect at approximately 20 m per minute while recording all birds seen or heard within 10 m in all directions. All surveys were terminated within three hours after sunrise. We rotated the sequence of surveys such that each site was sampled at least once during each of the 3 h following sunrise, and surveys were distributed throughout each season.

We recorded birds only if observed within transect boundaries. Birds flying over transects but not specifically using a study site were excluded, whereas others such as Tree Swallows (*Tachycineta bicolor*) and Common Nighthawks (*Chordeiles minor*) that were foraging above a transect were included. (Scientific names in text only for species not included in Table 2.) Similarly, birds using a site beyond the transect width which then flew over the transect and again landed beyond the boundary but within the site were included. Turkey Vultures (*Cathartes aura*) using air currents above transects for patrolling were excluded from analysis since we considered the air current rather than the stand itself to be the attractant.

For statistical analyses, we pooled data from transects within sites. For each season we averaged over repeated samples (four) and years (two) within sites such that site ($N = 3$) was the replicate unit. We calculated bird density based on absolute area surveyed and converted to numbers/km^2. We compared densities of each bird species among treatments for each season using one-way analysis of variance (ANOVA). We used fixed-effect, two-

TABLE 1

MEAN (±SE) STRUCTURAL CHARACTERISTICS OF SAND PINE SCRUB HABITAT IN THREE TREATMENTS AND MATURE FOREST, OCALA NATIONAL FOREST, FLORIDA

Treatment	Percent cover: Pine	Shrub	Herb	Bare ground	Density (stems/ha) Pine	Height (>1 m) Pine
Burn (HIB)	55.38 (7.51)	47.79 (2.33)	8.76 (1.49)	16.67 (1.20)	4860.00 (344.87)	2.87 (0.09)
Chop (RC)	42.44 (5.90)	45.40 (1.27)	15.73 (5.08)	20.93 (1.25)	3680.00 (716.19)	2.77 (0.16)
Bracke (BK)	23.64 (3.81)	53.15 (1.21)	5.78 (0.14)	22.76 (5.06)	3373.33 (777.55)	1.79 (0.30)
Mature (MF)	87.38 (0.60)	78.53 (3.32)	28.95 (7.94)	0.00 (0.00)	691.67 (58.05)	17.12 (0.56)

way ANOVA to compare species richness, Shannon's diversity indices (Shannon 1948), and total bird densities among treatments and seasons. If season-treatment interaction was significant, we used pairwise contrasts between least square means from the split-plot ANOVA to determine season effects (if significant) and one-way ANOVA to determine treatment effects within seasons. Data were log-transformed when required to correct for nonnormality or heteroscedasticity. We computed Horn's Index of Community Similarity (Horn 1966) for all possible treatment pairs during both winter and spring and also to compare winter and spring bird communities within treatments.

We assigned species to residency status groups as well as to nesting guilds (Root 1967) to test for differences among treatments and/or seasons using two-way and one-way ANOVA, as described above. Residents were classified as permanent, breeding only, or winter only. Nesting guilds were defined as ground-, shrub-, cavity-, and canopy-nesters (Harrison 1975).

RESULTS

Habitat structure differed considerably between mature forest and disturbance treatments (Table 1). Pine density was strikingly lower and tree height greater in MF relative to disturbance treatments. Shrub and herbaceous plant cover also were higher and bare ground cover lower in MF relative to disturbance treatments. The scale of structural differences among disturbance treatments was small relative to differences between MF and the treatments. Herbaceous cover was dominated by lichens in MF and by vascular plants in early-successional stands (Greenberg, unpubl. data).

Differences in bird communities corresponded with habitat structure rather than with treatment per se. Vegetation structure, along with bird species composition (Table 2), richness and diversity (Table 3), and com-

TABLE 2

MEAN SPRING AND WINTER DENSITY (UPPER NUMBER) ± SE (LOWER NUMBER) PER KM^2 OF SELECT SPECIES OF BIRDS IN THREE TREATMENTS AND MATURE FOREST IN SAND PINE SCRUB

	Spring				Winter			
Species (code)[a]	Burn (HIB)	Chop (RC)	Bracke (BK)	Mature (MF)	Burn (HIB)	Chop (RC)	Bracke (BK)	Mature (MF)
Downy Woodpecker (PC)	X		X	19.5	X	X	5.6	16.7
(*Picoides pubescens*)				12.1			2.8	4.8
Northern Flicker (PC)	2.8	5.6	2.8	X	2.8	2.8	22.2	0.0
(*Colaptes auratus*)	2.8	5.6	2.8		2.8	2.8	7.4	
Red-bellied Woodpecker (PC)	X	X	2.8	5.6	X	2.8	X	8.3
(*Melanerpes carolinus*)			2.8	5.6		2.8		4.8
Great Crested Flycatcher (BC)	X	X	X	41.7				
(*Myiarchus crinitus*)				26.8				
Blue Jay (PT)	5.6	X	X	11.1	8.3	8.3	2.8	2.8
(*Cyanocitta cristata*)	5.6			2.8	4.8	8.3	2.8	2.8
Scrub Jay (PS)	22.2	19.5	16.7		X		27.8	
(*Aphelocoma coerulescens*)	12.1	12.1	9.6				14.7	
Ruby-crowned Kinglet (W)					25.0	11.1	16.7	72.2
(*Regulus calendula*)					0.0	5.6	4.8	29.0
Blue-gray Gnatcatcher (PT)	X	13.9	5.6	50.0	2.8	0.0	0.0	36.1
(*Polioptila caerulea*)		7.4	2.8	12.7	2.8			20.0
Brown Thrasher (PS)	5.6	41.7	2.8	X	X	2.8	2.8	X
(*Toxostoma rufum*)	5.6	17.4	2.3			2.8	2.8	
American Robin (W)					19.4	36.1	86.1	97.2
(*Turdus migratorius*)					5.6	23.7	46.7	97.2
Yellow-throated Vireo (BT)			X	5.6				
(*Vireo flavifrons*)				5.6				
White-eyed Vireo (PS)	X	102.8	5.6	13.9	2.8	27.8	2.8	13.9
(*V. griseus*)		75.5	5.6	5.6	2.8	14.7	2.8	7.4

TABLE 2
CONTINUED

Species (code)[a]	Spring				Winter			
	Burn (HIB)	Chop (RC)	Bracke (BK)	Mature (MF)	Burn (HIB)	Chop (RC)	Bracke (BK)	Mature (MF)
Palm Warbler (W)					33.3	52.8	41.7	36.1
(*Dendroica palmarum*)					4.8	7.4	14.4	32.0
Pine Warbler (PT)				19.4	13.9	X	2.8	225.0
(*D. pinus*)				10.0	5.6		2.8	55.5
Yellow-rumped Warbler (W)					75.0	30.6	166.7	47.2
(*D. coronata*)					44.1	12.1	145.9	26.5
Common Yellowthroat (PS)	X	30.6	2.8		2.8	8.3	27.8	0.0
(*Geothlypis trichas*)		16.9	2.8		2.8	4.8	5.6	
Northern Cardinal (PS)	58.3	13.9	27.8	8.3	55.6	8.3	111.1	16.7
(*Cardinalis cardinalis*)	4.8	7.4	13.9	4.8	10.0	8.3	48.2	4.8
Rufous-sided Towhee (PS)	286.1	419.4	300.0	147.2	197.2	372.2	336.1	111.1
(*Pipilo erythrophthalmus*)	36.4	38.6	16.7	15.5	36.4	124.0	26.5	19.5
Summer Tanager (BT)	0.0	0.0	0.0	16.7				
(*Piranga rubra*)				4.8				

[a] Species code adheres to the following pattern. First letter, residency status—B = breeding resident; P = permanent resident; W = winter resident. Second letter, nesting guild (location of nest)—C = cavity; G = ground; S = shrub; T = tree. X indicates species was observed within a study site but was not recorded within transects.

TABLE 3

MEAN SPRING AND WINTER BIRD DENSITY, SPECIES RICHNESS, AND SHANNON'S DIVERSITY INDICES (±SE) IN THREE TREATMENTS AND MATURE FOREST IN SAND PINE SCRUB

Treatment	Density/km²	Richness	Diversity (H')
	Spring		
Burn (HIB)	388.9 ± 34.8	4.7 ± 0.3[a]	0.37 ± 0.03[a]
Chop (RC)	580.6 ± 59.8	6.3 ± 0.3[a]	0.43 ± 0.05[a]
Bracke (BK)	372.2 ± 20.0	5.3 ± 0.3[a]	0.32 ± 0.04[a]
Mature (MF)	372.2 ± 40.4	11.5 ± 1.5[b]	0.75 ± 0.06[b]
F	1.05	15.57	19.57
P	0.420	0.0005	0.0005
df	3	3	3
	Winter		
Burn (HIB)	530.6 ± 60.9	12.0 ± 1.0	0.84 ± 0.00[a,b]
Chop (RC)	594.4 ± 121.8	10.3 ± 1.2	0.61 ± 0.07[c]
Bracke (BK)	894.4 ± 207.5	11.0 ± 1.2	0.73 ± 0.03[a,c]
Mature (MF)	705.6 ± 140.8	11.7 ± 1.8	0.87 ± 0.02[b]
F	1.05	0.032	8.77
P	0.420	0.811	0.007
df	3	3	3

[a,b,c] Different letters within a column denote significant differences among treatments ($P < 0.05$). Data log-transformed for ANOVA.

TABLE 4

HORN'S INDEX OF COMMUNITY SIMILARITY (R_0) FOR SPRING AND WINTER BIRD COMMUNITIES IN THREE TREATMENTS AND MATURE FOREST IN SAND PINE SCRUBA[a]

	Burn (HIB)	Chop (RC)	Bracke (BK)
	Spring		
Burn (HIB)			
Chop (RC)	0.862		
Bracke (BK)	0.947	0.929	
Mature (MF)	0.594	0.641	0.655
	Winter		
Burn (HIB)			
Chop (RC)	0.807		
Bracke (BK)	0.848	0.828	
Mature (MF)	0.686	0.606	0.653

[a] Values closer to 1.0 indicate greater community similarity between treatments.

TABLE 5

HORN'S INDEX OF COMMUNITY SIMILARITY (R_0) FOR WINTER VS SPRING BIRD COMMUNITIES IN THREE TREATMENTS AND MATURE FOREST IN SAND PINE SCRUB[a]

	Winter			
Spring	Burn (HIB)	Chop (RC)	Bracke (BK)	Mature (MF)
Burn (HIB)	0.669			
Chop (RC)		0.782		
Bracke (BK)			0.738	
Mature (MF)				0.583

[a] Values closer to 1.0 indicate greater community similarity between treatments.

munity overlap (Table 4) were significantly different between MF and each of the disturbance treatments.

Species richness (F = 39.24, df = 1, P = 0.0002) and diversity (F = 57.48, df = 1, P = 0.0001) were higher in winter than in spring for all disturbance treatments but not in MF (Table 3). In spring, MF had significantly higher species richness and diversity than disturbance treatments. There were no treatment differences in species richness in winter, but diversity was significantly lower in RC than in HIB or MF.

Bird density was significantly higher in winter than in spring in BK and MF (F = 11.01, df = 1, P = 0.011), but there was no treatment effect (Table 3). Within treatments, Horn's Index of Community Similarity indicated seasonal differences in community overlap; differences were most marked in MF (Table 5).

Permanent residents were numerically dominant during the breeding season (Fig. 1). There were no treatment (F = 2.21, df = 3, P = 0.165) or seasonal (F = 0.04, df = 1, P = 0.843) differences in permanent resident densities. Among permanent residents, Rufous-sided Towhees were numerically dominant in both seasons, but numbers were proportionally lower in winter due to the influx of migratory winter residents.

Species richness of permanent residents did not differ between seasons (F = 3.08, df = 1, P = 0.117) (Fig. 2). Among treatments, MF contained higher species richness of permanent residents (F = 4.81, df = 3, P = 0.034) than HIB or RC (suggested for BK; P = 0.072). Permanent residents occurring primarily in MF included several woodpeckers and the Pine Warbler.

Density and species richness of breeding-only birds were significantly higher in MF than in disturbance treatments (F = 3.65, df = 3, P = 0.037 and F = 17.22, df = 3, P = 0.0008, respectively) (Figs. 1 and 2). Breed-

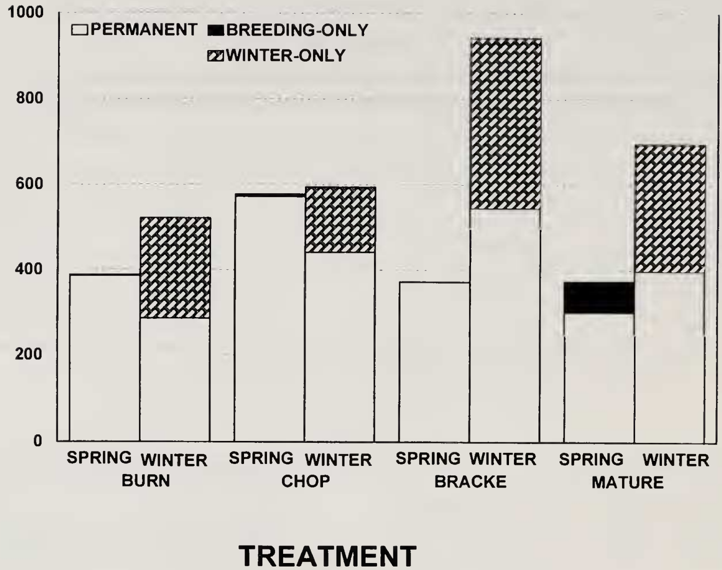

FIG. 1. Mean spring and winter density of permanent, breeding only, and winter-only residents in three treatments and mature forest in sand pine scrub.

ing-only species included the Great Crested Flycatcher, Summer Tanager, and Yellow-throated Vireo.

In winter, winter-only residents became numerically dominant (54–80% of total winter bird density). However, neither density nor species richness of this group differed among treatments or MF (F = 0.83, df = 3, P = 0.512 and F = 0.65, df = 3, P = 0.606, respectively) (Figs. 1 and 2). Common winter-only species included American Robin, Yellow-rumped Warbler, and Palm Warbler.

Nesting Guild

During the breeding season, treatment differences in species richness, composition, and relative densities of nesting guilds corresponded closely to habitat structure. Shrub-nesters (predominantly Rufous-sided Towhees) comprised >95% of total breeding bird density in all disturbance treatments and >45% in MF (Fig. 3).

Cavity nesters such as woodpeckers and the Great Crested Flycatcher, and canopy nesters such as the Blue-gray Gnatcatcher and Pine Warbler were also important in mature forest where tree boles and canopy provide additional niche dimensions. The density and species richness of canopy-nesting species were significantly higher in MF than in disturbance treat-

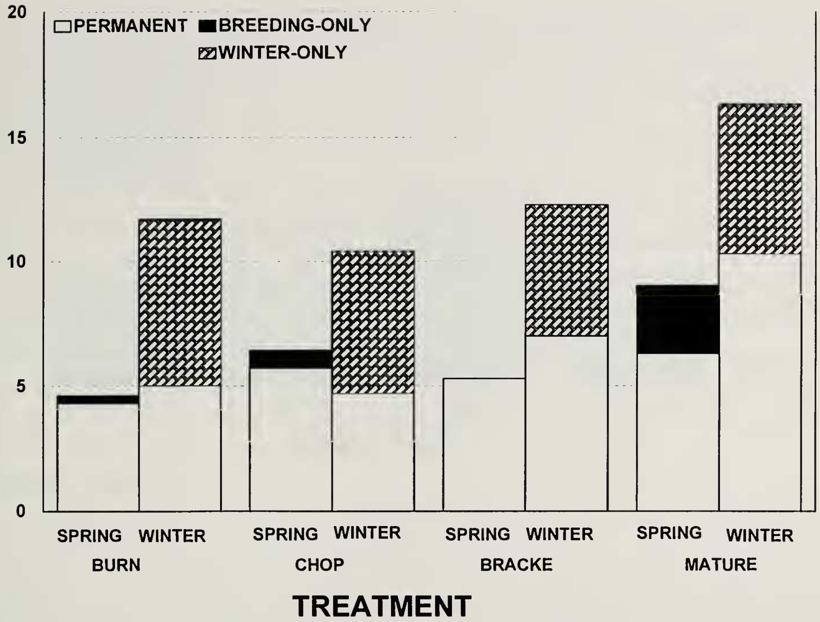

FIG. 2. Mean spring and winter species richness of permanent, breeding only, and winter-only residents in three treatments and mature forest in sand pine scrub.

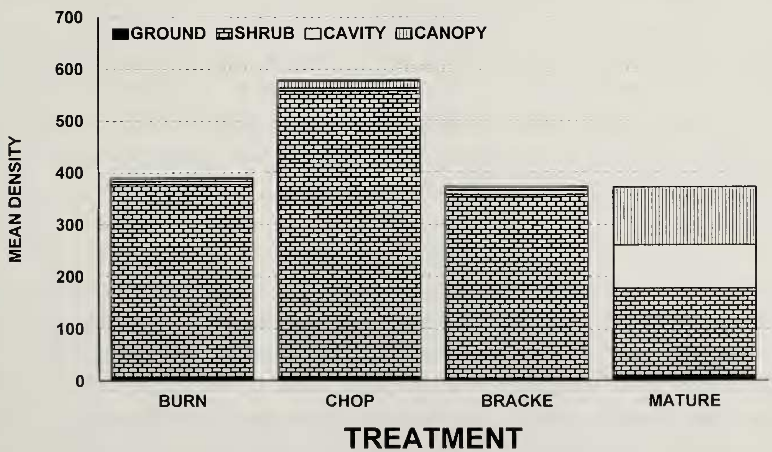

FIG. 3. Mean density of ground-, shrub-, cavity-, and canopy-nesting birds in three treatments and mature forest in sand pine scrub.

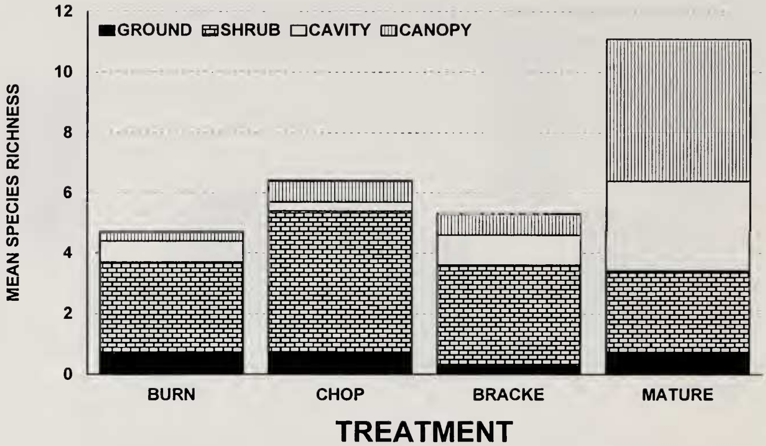

FIG. 4. Mean species richness of ground-, shrub-, cavity-, and canopy-nesting birds in three treatments and mature forest in sand pine scrub.

ments ($F = 4.37$, df = 3, $P = 0.042$ and $F = 21.86$, df = 3, $P = 0.0003$, respectively) (Figs. 3 and 4). Cavity nesters also tended to be more abundant ($F = 2.93$, df = 3, $P = 0.0995$) and species rich ($F = 3.04$, df = 3, $P = 0.093$) in MF than in disturbance treatments.

Conversely, fewer shrub-nesting species occurred in MF than in disturbance treatments, but more in RC than in HIB or BK ($F = 4.61$, df = 3, $P = 0.037$) (Fig. 4). Also, shrub-nesters were less abundant in MF than in disturbance treatments but more abundant in RC than in HIB or BK ($F = 35.89$, df = 3, $P = 0.0001$) (Fig. 3).

Neither density nor species richness of ground nesters differed among treatments ($F = 0.29$, df = 3, $P = 0.831$ and $F = 0.25$, df = 3, $P = 0.859$, respectively). Differences in occurrence and abundance of individual breeding bird species appeared to reflect differences in nesting habits (Table 2).

DISCUSSION

Our results support the hypothesis that similar bird communities occur in like-structured sand pine scrub habitat that results from high-intensity disturbance regardless of the means of disturbance. Because safety and economic considerations often prohibit the use of wildfire as a sand pine scrub management technique, clearcutting may be a viable way to create habitat for the Florida Scrub Jay and other scrub biota which depend on early successional scrub habitat.

Previous researchers (MacArthur and MacArthur 1961, Shugart and

James 1973, James and Wamer 1982) have demonstrated that bird species richness and diversity are positively correlated with increasing vertical and horizontal habitat structure. Our results also suggest that habitat structure governed most of the observed differences in species composition and diversity between MF and disturbance treatments. The presence of tall trees in MF provided additional foraging and nesting locations in and on tree boles and canopy. Community differences were especially apparent during the breeding season.

However, habitat structure appeared to be less important in winter. Although permanent MF residents such as most woodpeckers retained their forest association in winter, many winter-only birds such as Yellow-rumped Warbler, Palm Warbler, American Robin, Ruby-crowned Kinglet, House Wren (*Troglodytes aedon*), and Eastern Phoebe (*Sayornis phoebe*) appeared to be habitat-structure generalists on their sand pine scrub wintering grounds.

Our study was hampered by the absence of a true disturbance "control" (unsalvaged burn). By attracting such species as the Great Crested Flycatchers and woodpeckers, snag retention in high-intensity burns would likely have increased bird diversity for as long as they remained standing. Dead standing trees provide perching, nesting, and foraging sites for birds and attract insect prey (Conner 1978). Breininger and Smith (1992) found a positive correlation between woodpeckers and snag density in coastal scrub.

Bird species composition in our study was similar to that found in structurally similar scrub habitats (Woolfenden 1969, 1970; FGFWFC 1976; Breininger and Schmalzer 1990). Our density estimates were similar to Woolfenden's (1969, 1970) but lower than those reported by Breininger and Schmalzer (1990). Breininger and Schmalzer (1990) suggest that high bird densities in coastal versus interior (Woolfenden 1969, 1970) scrub result from differences in vegetation structure and composition, soil moisture, productivity, or geographical location. Population fluctuations among years as well as differences in density estimates resulting from survey techniques must also be considered.

Our data support the hypothesis that clearcutting mimics high-intensity burns that are followed by salvage-logging and in the short term does not appear to threaten the characteristic bird community of open sand pine scrub. Where natural disturbance processes are incompatible with other management objectives, clearcutting (with qualifications, such as increased snag and shrub retention) large patches of sand pine scrub on 50-year rotations may maintain suitable habitat for both forested and non-forested scrub bird communities. Fifty-year rotations approach the natural longevity of sand pine and probably mimic the average return interval of high-intensity wildfire in sand pine scrub (Myers 1990). Long rotations will enhance diversity by providing a succession of habitats for migratory breeding birds and will ensure a "sustainable yield" of age-class or structure-class habitat availability for both open-scrub and forested sand pine scrub bird communities.

The limited scope of our study warrants cautious interpretation and implementation of our results. Further study is required to evaluate and improve ecosystem management in conjunction with forestry objectives in sand pine scrub. The long-term effects within and spanning several rotations of site degradation resulting from intensive site preparation could have negative consequences for open scrub bird communities and should be studied further. We did not address the potentially critical roles of standing snags and coarse woody debris following high-intensity burns in sand pine scrub. Finally, landscape patterns created by clearcut patches (Harris 1984, Franklin and Forman 1987) differ in size and arrangement from the landscape mosaic created by natural disturbance and could affect bird populations.

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SOUTHERN HEMISPHERE ORNITHOLOGICAL CONGRESS

The Southern Hemisphere Ornithological Congress will be held 5–9 October 1996, in Albany, Australia. The meetings are organized by the Royal Australasian Ornithologists Union and will focus upon southern hemisphere birds and their habitats. Subthemes will include conservation and management, impact of fire, breeding biology, studies of seabirds and waders, foraging behavior, and plant-bird interactions. Persons seeking additional information should contact Brian Collins, School of Environmental Biology, Curtin University of Technology, GPA Box U 1987, Perth, Western Australia 6001 (Phone: 619 351 7054; FAX: 619 351 2495; email: B.Collins@info.curtin,edu.au).